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ABSTRACT

The Minnesota Sea Grant Education Sub-program provided funds to the University of Minnesota in 1980 to develop aquatic education materials (dealing with freshwater systems) for grades 5-9. The project resulted in the development and classroom testing of 13 instructional modules. A second grant (1982) funded workshops to introduce Minnesota teachers to aquatic activities. The project also produced two sourcebooks cataloging these materials. A group of science educators then met to develop a set of objectives for aquatic education unique to Minnesota educational needs. These objectives, presented in the form of critical topic areas (water and society, water in nature, and attitudes/experiences) provided the focus for an assessment of Northern Minnesota teachers' knowledge and priority for selected aquatic education topics. Fifty-five teachers attending one of four workshops on environmental education completed a questionnaire (included in an appendix), assessing knowledge of and educational priorities for sixteen aquatic topics. Although teachers rated themselves as knowledgeable about aquatic topics, they rated aquatic topics low in educational priority when compared to teachers in Mississippi and Alabama. However, six topics appear to be prime areas for future curriculum development. These include aquatic ecology, water table, wetlands, toxic waste dumping, aquatic foodwebs, and influence of aquatic environment on man. (Author/JN)

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Teachers and Aquatic Education-A Survey

by

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A paper presented at the Minnesota Academy of Sciences Meeting at Gustavus
Adolphus College, St. Peter, Minnesota on April 24, 1982.

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INTRODUCTION

The Minnesota Sea Grant Education Sub-program provided funds to the University of Minnesota in 1980 for the purpose of developing aquatic curricula for grades 5 through 9. This project resulted in the development and classroom testing of thirteen instructional modules. A second grant in 1982 funded workshops to introduce Minnesota teachers to aquatic activities, both those developed in Minnesota and those developed in other states but appropriate for Minnesota needs. This project also produced two "sourcebooks" cataloging these materials.

The materials developed in the Year One project and the choice of materials for the Year Two project were based upon national marine education objectives (Goodwin and Schaadt, 1978; Spector, 1979). It became evident,

however, that the marine focus of these objectives rendered them of only limited utility for Minnesota teachers. Consequently a group of science educators met to develop a set of objectives for aquatic education unique to Minnesota educational needs. These objectives, presented in the form of critical topics, are listed in Table 1. These topic areas provide the focus for this assessment of Northern Minnesota teachers'

TABLE 1
MINNESOTA WATER TOPIC AREAS

A. WATER AND SOCIETY

(1). Water in Our Daily Lives

e.g., water in our homes, city water supplies, transportation and recreational uses of water

(2). Water in History and as a Part of Culture

e.g., importance of water in the choice of sites for cities, importance of Lake Superior in Minnesota's cultural history

(3). The Water Quality Problem

e.g., water shortage, water pollution

B. WATER IN NATURE

(1). Nature's Water Cycle

e.g., characteristics of lakes and streams, the water cycle, the water table, water in erosion, distribution of freshwater

(2). Properties of Water

e.g., physical and chemical properties of water

(3). Life in Water

e.g., biological properties of water, water organisms

C. ATTITUDES AND EXPERIENCES

(1). Attitudes About Water

e.g., importance of protecting water supply, perceived magnitude of the water problem, value for freshwater resources

(2). Experiences With Water

e.g., field trips and vacations to lake areas, ability to swim, films and books about water

TABLE 2
CHARACTERISTICS OF THE STUDY SAMPLE

<u>WORKSHOP SITE</u>	<u>GRADE LEVEL</u>	<u>NUMBER OF TEACHERS</u>
DEER RIVER	ELEMENTARY	0
	JUNIOR HIGH	6
	SENIOR HIGH	7
	TOTAL	13
MOOSE LAKE	ELEMENTARY	0
	JUNIOR HIGH	3
	SENIOR HIGH	8
	MISSING DATA	1
	TOTAL	12
PEQUOT LAKE	ELEMENTARY	4
	JUNIOR HIGH	6
	SENIOR HIGH	9
	TOTAL	12
VIRGINIA	ELEMENTARY	0
	JUNIOR HIGH	4
	SENIOR HIGH	7
	TOTAL	11

knowledge and priority for selected aquatic education topics.

SAMPLE

Individuals sampled in this survey consisted of 55 teachers attending one of four workshops on environmental education held in Northern Minnesota. Table 2 shows the distribution of teachers by workshop site and grade level taught.

THE QUESTIONNAIRE

The questionnaire (see Appendix) consisted of two sections. The first section called

for responses concerning teachers' assessment of their knowledge of sixteen aquatic topics. The second section called for responses concerning teachers' assessment of the educational priority of the same sixteen topics.

The questionnaire was adapted from a study by the Mississippi-Alabama Sea Grant Program (Milkent, Irby and Story, 1979). Ten of the sixteen topics were derived from that study with the adaptation that the term "marine" was changed to "aquatic" in each case (e.g., "marine ecology" became "aquatic ecology"). Additional topics were chosen to assess areas specific to Minnesota aquatic conditions. These topics, divided among the Minnesota Water Topic Areas are shown in Table 3.

TABLE 3
QUESTIONNAIRE TOPICS BROKEN DOWN
BY MINNESOTA WATER TOPIC AREAS

- A1 - WATER IN OUR DAILY LIVES
 - CONSERVATION LEGISLATION
 - INFLUENCE OF AQUATIC ENVIRONMENTS ON MAN
- A2 - WATER IN HISTORY AND AS A PART OF CULTURE
 - FISHERIES INDUSTRY
 - ECONOMIC IMPORTANCE OF WATER
- A3 - THE WATER QUALITY PROBLEM
 - TOXIC WASTE DUMPING
 - POLLUTION OF WATER
- B1 - NATURE'S WATER CYCLE
 - THE WATER CYCLE
 - WATER TABLE
 - THE GREAT LAKES
- B2 - PROPERTIES OF WATER
 - PROPERTIES OF WATER
- B3 - LIFE IN WATER
 - AQUATIC ECOLOGY
 - WETLANDS
 - AQUATIC FOOD WEBS
 - AQUATIC PLANTS
 - AQUATIC ANIMALS
- C1 - ATTITUDES ABOUT WATER
 - AESTHETIC VALUE OF WATER

RESULTS

Teachers Assessment of Their Knowledge

Teachers were asked to judge their competency in teaching sixteen aquatic topics by using the following scale:

- 1 Unaware of topic or its meaning
- 2 Aware of topic, but have little specific knowledge regarding topic
- 3 Have some knowledge of the topic, but inadequate knowledge for teaching topic
- 4 Have adequate knowledge for the teaching of the topic
- 5 Have above average knowledge for teaching of topic.

TABLE 4
TEACHER'S PERCEIVED KNOWLEDGE OF SELECTED AQUATIC TOPICS

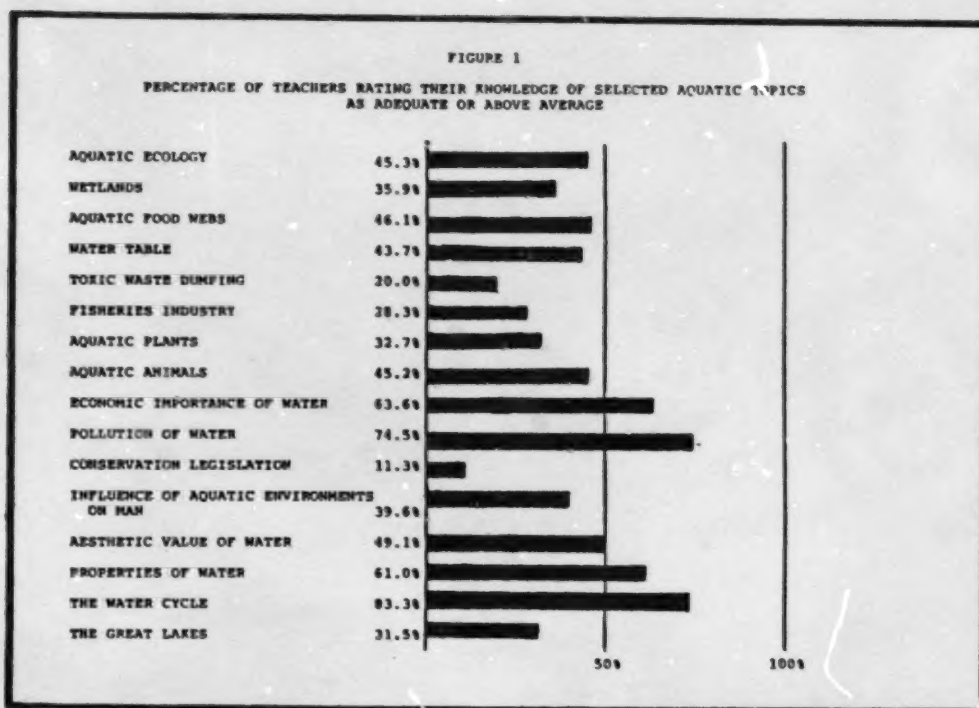
TOPIC	KNOWLEDGE	
	MEAN	STANDARD DEVIATION
AQUATIC ECOLOGY	3.32	1.05
WETLANDS	3.19	0.86
AQUATIC FOOD WEBS	3.25	1.08
WATER TABLE	3.36	0.85
TOXIC WASTE DUMPING	2.87	0.77
FISHERIES INDUSTRY	2.96	0.94
AQUATIC PLANTS	3.11	0.94
AQUATIC ANIMALS	3.38	0.90
ECONOMIC IMPORTANCE OF WATER	3.69	0.84
POLLUTION OF WATER	3.82	0.75
CONSERVATION LEGISLATION	2.72	0.79
INFLUENCE OF AQUATIC ENVIRONMENTS ON MAN	3.28	0.76
AESTHETIC VALUE OF WATER	3.55	0.92
PROPERTIES OF WATER	3.80	0.84
THE WATER CYCLE	4.02	0.71
THE GREAT LAKES	3.19	0.68

The sixteen topics as well as the mean and standard deviation for each topic are presented in Table 4. The topic for which the teachers rated their knowledge the highest was "the water cycle" while the topic receiving the lowest rating was "conservation legislation". However, only five of the sixteen topics had a mean rating of 3.5 or greater and only one topic, "the water cycle" had a rating greater than 4.0. This indicates that a significant number of teachers feel that they do not have an adequate knowledge to teach certain topics.

Table 5 shows the results of teachers' assessment of their knowledge broken down by Minnesota Water Topic Areas. The topic area for which teachers rated their knowledge highest was "properties of water" while the topic area receiving the lowest rating was "water in our daily lives". Only two of the six topics had a mean rating greater than 3.5 and none had a rating greater than 4.0.

TABLE 5
TEACHERS' PERCEIVED KNOWLEDGE OF SELECTED AQUATIC TOPICS
BROKEN DOWN BY MINNESOTA WATER TOPIC AREAS

TOPIC	KNOWLEDGE	
	MEAN	STANDARD DEVIATION
A1 - WATER IN OUR DAILY LIVES	3.00	0.78
A2 - WATER IN HISTORY AND AS A PART OF CULTURE	3.33	0.89
A3 - THE WATER QUALITY PROBLEM	3.35	0.76
B1 - NATURE'S WATER CYCLE	3.52	0.75
B2 - PROPERTIES OF WATER	3.80	0.84
B3 - LIFE IN WATER	3.25	0.97
C1 - ATTITUDES ABOUT WATER	3.55	0.92



Responses 4 and 5 were combined and the percent of teachers ranking their knowledge as adequate or above average for each topic is shown in Figure 1. There were only four of the sixteen topics for which a majority of the teachers considered themselves adequate.

Assessment of the Priority of Marine Topics

Teachers were asked to assess the priority that each of the sixteen topics should be given in their curricula. The following scale was used:

- 1 Lowest priority (should not be included)
- 2 Low priority
- 3 Inclusion is questionable
- 4 High priority
- 5 Highest priority (most definitely included)

TABLE 6
TEACHERS' PRIORITY FOR SELECTED AQUATIC TOPICS

TOPIC	PRIORITY	
	MEAN	STANDARD DEVIATION
AQUATIC ECOLOGY	3.28	1.18
WETLANDS	3.12	1.10
AQUATIC FOOD WEBS	3.26	1.26
WATER TABLE	3.28	0.99
TOXIC WASTE DUMPING	3.35	1.03
FISHERIES INDUSTRY	2.69	1.14
AQUATIC PLANTS	2.98	1.15
AQUATIC ANIMALS	3.06	1.19
ECONOMIC IMPORTANCE OF WATER	3.80	0.97
POLLUTION OF WATER	4.09	0.76
CONSERVATION LEGISLATION	2.81	1.12
INFLUENCE OF AQUATIC ENVIRONMENTS ON MAN	3.35	1.01
AESTHETIC VALUE OF WATER	3.25	1.09
PROPERTIES OF WATER	3.77	0.95
THE WATER CYCLE	3.98	0.82
THE GREAT LAKES	3.21	0.90

The sixteen topics as well as the mean and standard deviation for each topic are presented in Table 6. The topic given highest priority by teachers was "pollution of water" while the topic "fisheries industry" received the lowest priority.

Table 7 shows the results of teachers' assessment of the priority of aquatic topics broken down by Minnesota Water Topic Areas.

The topic area which teachers rated highest in priority was "properties of

water" while the topic area receiving the lowest rating was "water in our daily lives". Only two of the six topic areas had mean ratings greater than 3.5 and none had a rating greater than 4.0.

Responses 4 and 5 were combined and the percent of teachers judging each topic as being of high or highest priority in their curriculum is shown in Figure 2. Eight of the topics were judged of high priority.

TABLE 7
TEACHERS' PRIORITY FOR SELECTED AQUATIC TOPICS
BROKEN DOWN BY MINNESOTA WATER TOPIC AREAS

TOPIC	PRIORITY	
	MEAN	STANDARD DEVIATION
A1 - WATER IN OUR DAILY LIVES	3.08	1.07
A2 - WATER IN HISTORY AND AS A PART OF CULTURE	3.23	1.06
A3 - THE WATER QUALITY PROBLEM	3.72	0.90
B1 - NATURE'S WATER CYCLE	3.49	0.90
B2 - PROPERTIES OF WATER	3.77	0.95
B3 - LIFE IN WATER	3.14	1.18
C1 - ATTITUDES ABOUT WATER	3.25	1.09

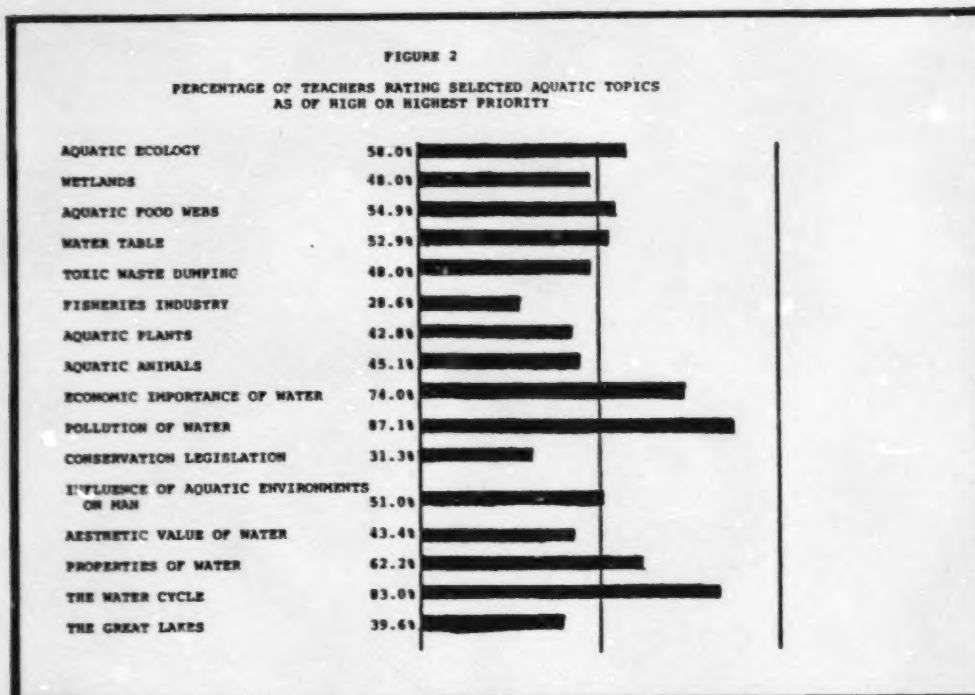


Table 8 shows a comparison between teachers' knowledge and priority of the 10 topics common between the two studies.

Minnesota teachers rated their knowledge higher than Mississippi-Alabama teachers on each of the ten topic areas. However, Mississippi-Alabama teachers rated the topics of higher priority than Minnesota

TABLE 8

COMPARISON OF MINNESOTA AND MISSISSIPPI-ALABAMA STUDIES

MINNESOTA STUDY		MISSISSIPPI-ALABAMA STUDY	
MEAN KNOWLEDGE SCORE			
AQUATIC ECOLOGY	3.32	MARINE ECOLOGY	2.99
AQUATIC FOOD WEBS	3.25	MARINE FOOD WEBS	3.07
AQUATIC PLANTS	3.11	DIVERSITY OF MARINE PLANTS	2.69
AQUATIC ANIMALS	3.38	DIVERSITY OF MARINE ANIMALS	3.07
ECONOMIC IMPORTANCE OF WATER	3.69	MARINE RELATED ECONOMICS	2.60
POLLUTION OF WATER	3.82	POLLUTION OF THE SEA	2.93
CONSERVATION LEGISLATION	2.72	CONSERVATION LEGISLATION	2.44
INFLUENCE OF AQUATIC ENVIRONMENTS ON MAN	3.28	INFLUENCE OF THE MARINE ENVIRONMENT ON MAN	3.01
AESTHETIC VALUE OF WATER	3.55	AESTHETIC VALUE OF WATER	2.87
PROPERTIES OF WATER	3.80	PROPERTIES OF SEA WATER	2.87
MEAN PRIORITY SCORE			
AQUATIC ECOLOGY	3.28	MARINE ECOLOGY	4.41
AQUATIC FOOD WEBS	3.26	MARINE FOOD WEBS	3.77
AQUATIC PLANTS	2.98	DIVERSITY OF MARINE PLANTS	3.74
AQUATIC ANIMALS	3.06	DIVERSITY OF MARINE ANIMALS	3.80
ECONOMIC IMPORTANCE OF WATER	3.80	MARINE RELATED ECONOMICS	3.32
POLLUTION OF WATER	4.09	POLLUTION OF THE SEA	4.10
CONSERVATION LEGISLATION	2.81	CONSERVATION LEGISLATION	2.99
INFLUENCE OF AQUATIC ENVIRONMENTS ON MAN	3.35	INFLUENCE OF THE MARINE ENVIRONMENT ON MAN	4.11
AESTHETIC VALUE OF WATER	3.25	AESTHETIC VALUE OF WATER	2.71
PROPERTIES OF WATER	3.77	PROPERTIES OF SEA WATER	3.23

teachers with the exception of three, "economic importance of water", "aesthetic value of water", and "properties of water". This might be explained in part by the fact that the Minnesota study asked teachers to rate the priority of the topics in their curriculum while the Mississippi-Alabama study asked teachers to rate the priority of the topics in the development of marine education curricular materials.

CONCLUSIONS

Any conclusions drawn from these results must be tentative in light of the small sample size drawn from a limited geographical area. Yet, teachers motivated to attend an environmental workshop will most likely be those teachers willing to teach environmental topics. This generalization is supported by the fact that 74% of the participants indicated that they presently teach some water related units. With these limitations in mind, the following conclusions can be drawn.

1. Teachers in Minnesota rate themselves as more knowledgeable about aquatic topics than do teachers in Mississippi and Alabama.
2. Teachers in Minnesota generally rate aquatic topics lower in priority than do teachers in Mississippi and Alabama.
3. Six topics appear to be prime areas for future curriculum development. These are topics for which a majority (or near majority of 48%) of teachers rated as high or highest priority, yet less than half considered their knowledge sufficient to teach the topic. These topics are:

Aquatic Ecology
Water Table
Wetlands
Toxic Waste Dumping
Aquatic foodwebs
Influence of Aquatic Environments on Man.

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APPENDIX

NAME (Optional) _____
 SCHOOL/CITY _____
 GRADE LEVEL(S) _____ SUBJECT(S) _____
 Do you currently teach any water related units? _____
 If so, describe. _____

What source materials do you use? _____

DIRECTIONS: For each topic below, circle the number in the left hand column that comes closest to describing your knowledge of the topic and circle the number in the right hand column that best describes the priority that you give the topic in your curriculum.

Unaware of topic or its meaning	Aware of topic but have little specific knowledge regarding topic	Have some knowledge of topic, but inadequate for teaching topic	Have adequate knowledge for teaching topic	Have above average knowledge for teaching topics	WATER TOPICS	Lowest priority (Should not be included)	Low priority	Inclusion is questionable	High priority	Highest priority (Most definitely included)
1	2	3	4	5	Aquatic ecology	1	2	3	4	5
1	2	3	4	5	Wetlands	1	2	3	4	5
1	2	3	4	5	Aquatic food webs	1	2	3	4	5
1	2	3	4	5	Water table	1	2	3	4	5
1	2	3	4	5	Toxic Waste Dumping	1	2	3	4	5
1	2	3	4	5	Fisheries Industry	1	2	3	4	5
1	2	3	4	5	Aquatic plants	1	2	3	4	5
1	2	3	4	5	Aquatic animals	1	2	3	4	5
1	2	3	4	5	Economic importance of water	1	2	3	4	5
1	2	3	4	5	Pollution of water	1	2	3	4	5
1	2	3	4	5	Conservation Legislation	1	2	3	4	5
1	2	3	4	5	Influence of aquatic environments on man	1	2	3	4	5
1	2	3	4	5	Aesthetic value	1	2	3	4	5
1	2	3	4	5	Properties of water	1	2	3	4	5
1	2	3	4	5	The Water Cycle	1	2	3	4	5
1	2	3	4	5	The Great Lakes	1	2	3	4	5